**KDB 865664 D01 SAR Measurement 100MHz to 6GHz**
**FCC 47 CFR part 2 (2.1093)**

# SAR EVALUATION REPORT

*For*

**Multi-purpose Precision Locator with Bluetooth Radio**

**Model Name/Number: RD8200SG**
**Contains FCC ID: K68-CLASSIC**
**Contains FCC ID: SQGBL652**

**REPORT NUMBER UL-SAR-RP14876167JD27A V3.0**
**ISSUE DATE: 20 NOV 2023**

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**REVISION HISTORY**

| Ver. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| 1.0 | 10 Nov 2023 | Initial Issue | -- |
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| | | | |
| | | | |

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# 1. Attestation of Test Results

| | | | | | | |
|---|---|---|---|---|---|---|
| **Applicant Name:** | Radiodetection Limited | | | | | |
| **Model Name/Number:** | RD8200SG | | | | | |
| **Test Device is** | A representative test sample | | | | | |
| **Device category** | Portable | | | | | |
| **Date Tested** | 17 October 2023 to 19 October 2023 | | | | | |
| **ICNIRP Guidelines Limits for SAR Exposure Characteristics** | General Population/Localised SAR (Extremity) – 10g-SAR limit 4.0 W/kg | | | | | |
| **The highest reported SAR values for Localized SAR** | RF Exposure Conditions | | Equipment Class | | | |
| | | | Licensed | DTS | U-NII | DSS |
| | Standalone | Extremity | N/A | N/A | N/A | 0.30 W/kg |
| | Simultaneous Transmission | Extremity | N/A | N/A | N/A | N/A |
| **Applicable Standards** | FCC 47 CFR part 2 (2.1093)<br>FCC KDB publication | | | | | |
| **Test Results** | Pass | | | | | |

UL International (UK) Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL International (UK) Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties are in accordance with the above standard and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample(s), under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL International (UK) Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL International (UK) Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by UKAS. This report is written to support regulatory compliance of the applicable standards stated above.

| Issued By: | Prepared By: |
|---|---|
|  |  |
| Naseer Mirza<br>Operations Leader | Muhammad Kunnumal<br>Laboratory Engineer |

# 2.Test Specification, Methods and Procedures

## 2.1.Test Specification

| Reference: | KDB Publication Number: 865664 D01 SAR Measurement 100 MHz to 6 GHz |
|---|---|
| **Title:** | SAR Measurement Requirements for 100 MHz to 6 GHz |
| **Introduction:** | The SAR Measurement procedures for 100MHz to 6GHz are described in this document. Field probes, tissue dielectric properties, SAR scans, measurement accuracy and variability of the measured results are discussed. The field probe and SAR scan requirements are derived from criteria considered in standard IEC/IEEE 62209-1528:2020. The wireless product and technology specific procedures in applicable KDB publications are required to be used unless further guidance has been approved by the FCC. |
| **Purpose of Test:** | To determine if the Equipment Under Test complies with the Specific Absorption Rate for general population/uncontrolled exposure limit of 1.6 W/kg as specified in FCC 47 CFR part 2 (2.1093). |

## 2.2.Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

**IEC/IEEE 62209-1528: 2020**

Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices.

**FCC KDB Publication:**
KDB 248227 D01 802.11 Wi-Fi SAR v02r02
KDB 447498 D03 Supplement C Cross-Reference v01
KDB 447498 D04 Interim General RF Exposure Guidance v01
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02 RF Exposure Reporting v01r02

## 2.3.Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Section 4.3 contains a list of the test equipment used.

# 3.Facilities and Accreditation

The measurement facilities used to collect data are located at

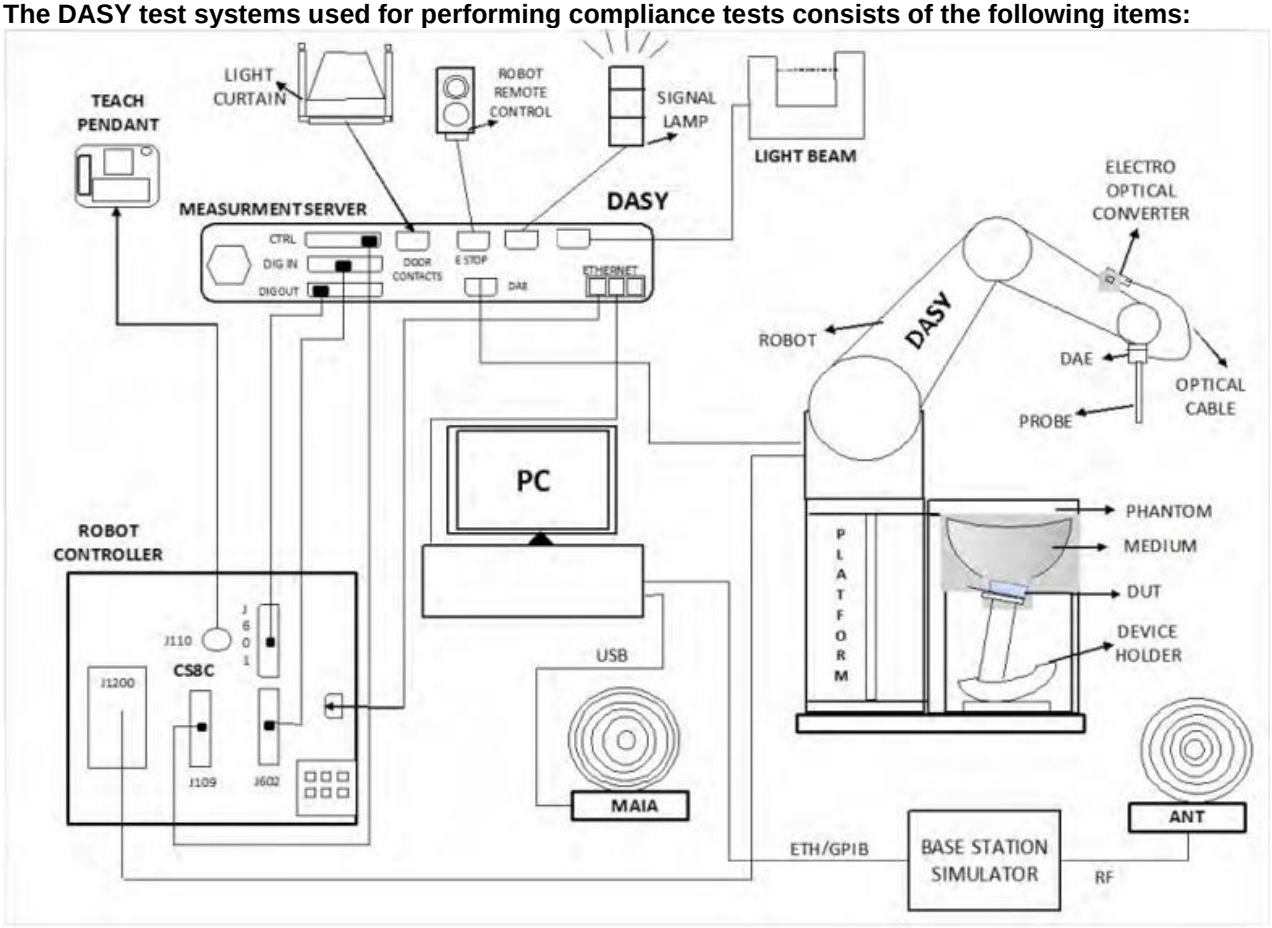
| Horizon Unit 1-4, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, UK | Facility Type |
|---|---|
| SAR Lab 67 | Controlled Environment Chamber |

UL International (UK) Ltd is accredited by UKAS (United Kingdom Accreditation Service, Accredited to ISO/IEC 17025:2017), Laboratory UKAS Code 5772.

# 4. SAR Measurement System & Test Equipment

## 4.1. SAR Measurement System

**The DASY test systems used for performing compliance tests consists of the following items:**




- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win10 with DASY software installed.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## 4.2.SAR Measurement Procedure

### 4.2.1.Normal SAR Measurement Procedure

The following procedure shall be performed for each of the test conditions

a) Measure the local SAR at a test point within 8 mm of the phantom inner surface that is closest to the DUT.

b) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grid spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3 GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δ ln(2)/2 mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and ln(x) is the natural logarithm. The maximum variation of the sensor-phantom surface distance shall be ± 1 mm for frequencies below 3 GHz and ± 0,5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional uncertainty evaluation is needed.

c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit (e.g., 1 W/kg for 1,6 W /kg 1 g limit, or 1,26 W/kg for 2 W /kg, 10 g limit).

d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step c) (zoom For frequencies at or below 3 GHz, the following procedure shall be applied: The horizontal grid step shall be 8 mm or less. The grid step in the vertical direction shall be 5 mm or less if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell (M1 and M2) shall be 4 mm or less and the spacing between farther points shall increase by a factor of 1,5 or less. The minimum size of the zoom scan volume shall be 30 mm by 30 mm by 30 mm

For frequencies above 3 GHz, the minimum size of the zoom scan volume may be reduced to 22 mm by 22 mm by 22 mm. The horizontal grid step shall be (24/*f* [GHz]) mm or less. If uniform spacing in the vertical direction is used, the grid step in the vertical direction shall be (10/(*f* [GHz] − 1)) mm or less. If variable spacing is used in the vertical direction, the maximum spacing between the two measured points closest to the phantom shell shall be (12/*f* [GHz]) mm or less and the spacing between further points shall increase by a factor of 1,5 or less. For other parameters, see Zoom Scan Parameters table.

When the highest 1 g or 10 g cube is touching the boundary of a zoom-scan volume, the entire zoom scan shall be repeated with the new centre located at the maximum psSAR location indicated by the preceding zoom scan measurement. If the zoom scan measured as defined above complies with both of the following criteria, or if the peak spatial-average SAR is below 0,1 W/kg, no additional measurements are needed:

1) the smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both *x* and y directions (Δ*x*, Δ*y*). This shall be checked for the measured zoom scan plane conformal to the phantom at the distance $z_{M1}$. The minimum distance shall be recorded in the SAR test report;

2) the ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the *x-y* location of the measured maximum SAR value shall be at least 30 %. This ratio (in %) shall be recorded in the SAR test report.

If one or both of the above criteria are not met, the zoom scan measurement shall be repeated using a finer resolution while keeping the other zoom scan parameters compatible with Zoom Scan Parameters table. New horizontal and vertical grid steps shall be determined from the measured SAR distribution so that the above criteria are met. Compliance with the above two criteria shall be demonstrated for the new measured zoom scan. The size of the higher resolution zoom scan and other parameters of Zoom Scan Parameters table shall apply. The closest point to the phantom shell shall be 2 mm or less for graded grids and the grading factor shall be 1,5 or less.

Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved if the distance between the phantom surface and physical tip of the probe is larger than the probe tip diameter. Other methods may utilize correction procedures to compensate for boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe normal to the flat phantom surface shall be less than 5º.

**Zoom Scan Parameters**

| Parameter | DUT transmit frequency being tested | |
|---|---|---|
| | $f \leq 3$ GHz | 3 GHz < $f \leq 6$ GHz |
| Maximum distance between the closest measured points and the phantom surface ($z_{M1}$ in Figure 14 and Table 2, in mm) | 5 | $\delta \ln(2)/2$ [a] |
| Maximum angle between the probe axis and the flat phantom surface normal ($\alpha$ in Figure 14) | 5° | 5° |
| Maximum spacing between measured points in the $x$- and $y$-directions ($\Delta x$ and $\Delta y$, in mm) | 8 | $24/f$ [b,c] |
| For uniform grids:<br>Maximum spacing between measured points in the direction normal to the phantom shell ($\Delta z_1$ in Figure 14, in mm) | 5 | $10/(f - 1)$ |
| For graded grids:<br>Maximum spacing between the two closest measured points in the direction normal to the phantom shell ($\Delta z_1$ in Figure 14, in mm) | 4 | $12/f$ |
| For graded grids:<br>Maximum incremental increase in the spacing between measured points in the direction normal to the phantom shell ($R_z = \Delta z_2/\Delta z_1$ in Figure 14) | 1,5 | 1,5 |
| Minimum edge length of the zoom scan volume in the $x$- and $y$-directions ($L_z$ in 7.2.5.3, in mm) | 30 | 22 |
| Minimum edge length of the zoom scan volume in the direction normal to the phantom shell ($L_h$ in 7.2.5.3, in mm) | 30 | 22 |
| Tolerance in the probe angle | 1° | 1° |
| [a] $\delta$ is the penetration depth for a plane-wave incident normally on a planar half-space.<br>[b] This is the maximum spacing allowed, which may not work for all circumstances.<br>[c] $f$ is the frequency in GHz. | | |

e) Use post processing (e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

f) The local SAR should be measured at the same location as in Step a). SAR drift is assessed and reported in the uncertainty budget.

In the event that the evaluation of measurement drift exceeds the 5 % tolerance, it is required that SAR be reassessed following guidelines contained within this standard.

If the drift is larger than 5 %, then the measurement drift shall be considered a bias, not an uncertainty. A correction shall be applied to the measured SAR value. It is not necessary to record the drift in the uncertainty budget (i.e. ui = 0 %). The uncertainty budget reported in a measurement report should correspond to the highest SAR value reported (after correction, if applicable). Alternatively, the uncertainty budget reported should cover all measurements, i.e., it should report a conservative value.

## 4.3. Test Equipment

Measuring equipment used to perform the tests is documented in this report and has been calibrated in accordance with UKAS' recommendations and is traceable to recognized national standards.

| UL Asset No. | Instrument Name | Manufacturer | Type | Serial No. | Date Last Calibrated | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| 168969 | E-Field Probe | SPEAG | EX3DV4 | 7497 | 17 Mar 2023 | 12 |
| 235306 | Data Acquisition Equipment | SPEAG | DAE4ip | 1793 | 03 Apr 2023 | 12 |
| 179511 | Phantom | SPEAG | ELI V8 | 2100 | Cal. as part of system | - |
| 234730 | Dipole Antenna | SPEAG | D2450V2 | 1097 | 02 Feb 2023 | 12 |
| 207451 | POWERSOURCE1 | SPEAG | SE UMS 160 CA | 4248 | 06 Nov 2022 | 12 |
| 234947 | Body Handset Positioner | SPEAG | MD4HACV5 | None | Cal. not required | - |
| 234953 | Head Handset Positioner | SPEAG | MD4HHTV5 | None | Cal. not required | - |
| 234931 | Measurement Server | SPEAG | - | 10103 | Cal. not required | - |
| 234956 | Phantom Support Structure | SPEAG | Phantom Table | - | Cal. not required | - |
| 234927 | Robot Arm | Staubli | TX2 60L | F/22/0042993/A/001 | Cal. not required | - |
| 234935 | Robot Power Supply | SPEAG | CS9C | F/22/0042993/C001 | Cal. not required | - |
| 241319 | MAIA | SPEAG | - | 1643 | Cal. not required | - |
| 230884 | Power Sensor | Rohde & Schwarz | NRP-18T | 102994 | 16 Jan 2023 | 12 |
| 174120 | Thermometer (Fluid) | Testo | Testo 720 | 3327513 | 27 Mar 2023 | 12 |
| 199469 | Thermometer (Fluid) | Testo | Testo 720 | 3465036 | 06 Apr 2023 | 12 |
| 147741 | Vector Network Analyser | Rohde & Schwarz | ZND 132.5170K92 | 100151 | 15 Feb 2023 | 12 |
| PRE0145189 | DAK 3.5 Fluid Probe | SPEAG | SM DAK 040 CA | 1089 | Cal. before use | - |
| 212960 | Digital Camera | Sony | DSC-HX400V | 3245687 | Cal. not required | - |
| PRE0195838 | RF Coax Cable | Taoglas | CAB.721 | | Cal. not required | - |
| PRE0195840 | RF Coax Cable | Taoglas | CAB.721 | | Cal. not required | - |
| PRE0136931 | RF Coax Cable | - | 70530/4PE | - | Cal. not required | - |
| PRE0140096 | RF Coax Cable | Huber+Suhner | ST18/SMAm/Nm/36 | - | Cal. not required | - |

### 4.3.1. SAR System Specifications

| | |
|---|---|
| **Robot System** | |
| **Positioner:** | Stäubli Unimation Corp. Robot Model: TX2-60L |
| **Repeatability:** | ±0.030 mm |
| **No. of Axis:** | 6 |
| **Serial Number(s):** | F/22/0042993/A/001 |
| **Reach:** | 920 mm |
| **Payload:** | 2.0 kg |
| **Control Unit:** | CS9C |
| **Programming Language:** | V+ |
| **Data Acquisition Electronic (DAE) System** | |
| **Serial Number:** | DAE4 SN: 1793 |
| **PC Controller** | |
| **PC:** | HP EliteDesk800 |
| **Operating System:** | Windows 10 |
| **Data Card:** | DASY Measurement Servers |
| **Data Controller** | |
| **Features:** | Signal Amplifier, multiplexer, A/D converted and control logic. |
| **Software:** | cDASY8 Software |
| **Connecting Lines:** | Optical downlink for data and status info.<br>Optical uplink for commands and clock. |
| **PC Interface Card** | |
| **Function:** | 24 bit (64 MHz) DSP for real time processing Link to DAE4 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot. |
| **Phantom** | |
| **Phantom:** | ELI Phantom |
| **Shell Material:** | Fibreglass |
| **Thickness:** | 2.0 ±0.2 mm |
| **E-Field Probe** | |
| **Model:** | EX3DV4 |
| **Serial No:** | 7497 |
| **Construction:** | Triangular core |
| **Frequency:** | 10 MHz to > 6 GHz |
| **Linearity:** | ±0.2 dB (30 MHz to 6 GHz) |
| **Probe Length (mm):** | 337 |
| **Probe Diameter (mm):** | 10 |
| **Tip Length (mm):** | 9 |
| **Tip Diameter (mm):** | 2.5 |
| **Sensor X Offset (mm):** | 1 |
| **Sensor Y Offset (mm):** | 1 |
| **Sensor Z Offset (mm):** | 1 |

# 5. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

| Test Name | Confidence Level | Calculated Uncertainty |
|---|---|---|
| Uncertainty- Freq. 300 MHz - 3 GHz Head & Body Configuration 10g | 95% | ±25.33% |

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

## 5.1.Uncertainty – Freq. 300MHz - 3 GHz Head & Body Configuration 10g

| Type | Source of uncertainty | + Value | - Value | Probability Distribution | Divisor | $c_{i\ (10g)}$ | Standard Uncertainty | | $\upsilon_i$ or $\upsilon_{eff}$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | + u (%) | - u (%) | |
| B | Probe calibration | 12.000 | 12.000 | normal (k=2) | 2.0000 | 1.0000 | 6.000 | 6.000 | ∞ |
| B | Probe calibration drift | 1.700 | 1.700 | Rectangular | 1.7321 | 1.0000 | 0.981 | 0.981 | ∞ |
| B | Probe Linearity and Detection Limits | 4.700 | 4.700 | Rectangular | 1.7321 | 1.0000 | 2.714 | 2.714 | ∞ |
| B | Broadband Signal | 3.000 | 3.000 | Rectangular | 1.7321 | 1.0000 | 1.732 | 1.732 | ∞ |
| B | Probe Isotropy | 7.600 | 7.600 | Rectangular | 1.7321 | 1.0000 | 4.388 | 4.388 | ∞ |
| B | Data Acquisition | 0.300 | 0.300 | normal (k=1) | 1.0000 | 1.0000 | 0.300 | 0.300 | ∞ |
| B | RF Ambient conditions | 0.260 | 0.260 | normal (k=1) | 1.0000 | 1.0000 | 0.260 | 0.260 | ∞ |
| B | Probe Positioning | 0.700 | 0.700 | normal (k=1) | 1.0000 | 0.1400 | 0.098 | 0.098 | ∞ |
| B | Data Processing Errors | 4.000 | 4.000 | Rectangular | 1.7321 | 1.0000 | 2.309 | 2.309 | ∞ |
| B | Uncertainty in SAR correction for deviations in permittivity and conductivity | 1.900 | 1.900 | normal (k=1) | 1.0000 | 0.8400 | 1.596 | 1.596 | ∞ |
| B | Liquid Conductivity (measured value) | 5.288 | 5.288 | normal (k=2) | 2.0000 | 0.0000 | 0.000 | 0.000 | ∞ |
| B | Liquid Permittivity (measured value) | 2.500 | 2.500 | normal (k=2) | 2.0000 | 0.0000 | 0.000 | 0.000 | ∞ |
| B | Liquid Conductivity (temperature uncertainty) | 1.430 | 1.430 | Rectangular | 1.7321 | 0.7100 | 0.586 | 0.586 | ∞ |
| B | Liquid Permittivity (temperature uncertainty) | 0.310 | 0.310 | Rectangular | 1.7321 | 0.7100 | 0.127 | 0.127 | ∞ |
| A | Phantom Shell Permittivity | 14.000 | 14.000 | Rectangular | 1.7321 | 0.2500 | 2.021 | 2.021 | ∞ |
| A | Distance DUT - TSL | 2.000 | 2.000 | normal (k=1) | 1.0000 | 2.0000 | 4.000 | 4.000 | ∞ |
| B | Test Sample Positioning | 4.240 | 4.240 | normal (k=1) | 1.0000 | 1.0000 | 4.240 | 4.240 | 25 |
| B | Device Holder uncertainty | 6.090 | 6.090 | normal (k=1) | 1.0000 | 1.0000 | 6.090 | 6.090 | 5 |
| B | DUT Modulation | 2.400 | 2.400 | Rectangular | 1.7321 | 1.0000 | 1.386 | 1.386 | ∞ |
| B | Drift of output power | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| | Combined standard uncertainty | | | t-distribution | | | 12.66 | 12.66 | 90 |
| | Expanded uncertainty | | | k = 2 | | | 25.33 | 25.33 | 90 |

# 6. Equipment Under Test (EUT)

## 6.1. Description of Equipment Under Test (EUT)

| | | |
|---|---|---|
| **Serial Number:** | Conducted Sample(s) | 10/82SG-US-991011 |
| | Radiated Sample(s) | 10/82SG-US-991027 |
| **Hardware Version Number:** | P2 | |
| **Software Version Number:** | N/A | |
| **Firmware Version Number:** | 4000 | |
| **Country of Manufacture:** | United Kingdom | |
| **Date of Receipt:** | 17 October 2023 | |
| **DUT Description:** | The DUT is a multi-purpose precision locator used for locating the position or path of buried pipes and cables, detecting insulation faults and creating survey records. It supports Bluetooth (Version 2.0 + EDR) and Bluetooth LE using pre-certified module FCC ID: SQGBL652 | |
| **Operating Configurations** | Hand-held | |
| **Device dimension** | Overall (Length x Width x Depth):<br>687 mm x 350 mm x 137 mm | |
| **Battery Type** | ☒ Standard – Lithium-ion battery<br>☐ Extended (large capacity) | |

## 6.2.Wireless Technologies

| Wireless technologies | Frequency bands | Operating mode | | Duty Cycle |
|---|---|---|---|---|
| Bluetooth | 2.4 GHz | ☒ Core Spec. 2.0<br>☐ Core Spec. 4.0<br>☐ Core Spec. 4.1<br>☐ Core Spec. 4.2<br>☐ Core Spec. 5.0 | ☐ Basic Rate (BDR)<br>☒ Enhanced Data Rate (EDR)<br>☒Low Energy (BLE)<br>☐ High Data Rate (HDR) | ☒ 77% (DH5, 720Kb/s)<br>☐ 77% (2-DH5/3-DH5, 2Mbps and 3Mbps)<br>☐ 60.5% (255 Bytes, 1Mbps)<br>☐ (4-DH5/8-DH5, 4Mbps and 8Mbps) |

Note: BT LE is exempt from SAR testing (See Report section 7.2)

| Bluetooth | | | | |
|---|---|---|---|---|
| **Band** | **Description** | | | |
| Bluetooth | Frequency Range: 2402 - 2480 MHz | | | |
| | Mode | Channel Number | Channel Description | Frequency (MHz) |
| | EDR Mode | 0 | Low | 2402.0 |
| | | 39 | Middle | 2441.0 |
| | | 78 | High | 2480.0 |

## Additional Information Related to Testing:

| | |
|---|---|
| **Antenna Type:** | Internal integral |
| **Antenna Lengths:** | As specified in **Appendix 11.1** |

| Number of Antennas: | Antenna Type | Antenna Description | Type |
|---|---|---|---|
| | WPAN | Bluetooth 2.4GHz | 2 fixed (Internal) |

## 6.3.Nominal and Maximum Output power:

| RF Air interface | Mode | Channel Nos. | Target + Max. Tolerances (dBm) |
|---|---|---|---|
| Bluetooth 2.4 GHz | EDR | All | 16.00 |

**Note(s):**

1. The nominal and maximum average source based rated powers declared and supplied by manufacturer are shown in the above table.

# 7. RF Exposure Conditions (Test Configurations)

## 7.1. Configuration Consideration

| Technology Port | Configuration | DUT-to-User Separation | Position | Antenna-to-Edge Separation (mm) | Evaluation Considered |
|---|---|---|---|---|---|
| Bluetooth 2.4 (Ant 1) | Extremity | 0mm | Back | < 50 | Yes |
| | | | Edge 1 (Top Edge) | < 50 | Yes |
| | | | Edge 2 (Right Edge) | > 50 | No |
| | | | Edge 3 (Bottom Edge) | < 50 | Yes |
| | | | Edge 4 (Left Edge) | < 50 | Yes |

| Technology Port | Configuration | DUT-to-User Separation | Position | Antenna-to-Edge Separation (mm) | Evaluation Considered |
|---|---|---|---|---|---|
| Bluetooth 2.4 (Ant 2) | Extremity | 0mm | Back | > 50 | No |
| | | | Edge 1 (Top Edge) | < 50 | Yes |
| | | | Edge 2 (Right Edge) | < 50 | Yes |
| | | | Edge 3 (Bottom Edge) | < 50 | Yes |
| | | | Edge 4 (Left Edge) | > 50 | No |

### Notes

1. The Antenna to edge separation distances are indicated in the 'Antenna Schematics' located in Section 11.1 of this report.
2. Prior to the SAR testing, KDB inquiry was raised with FCC for test approach/plan, all the configuration and position to be evaluated were agreed.

## 7.2. SAR Test Exclusion Consideration

| Frequency Band | Configuration(s) |
|---|---|
| | Extremity/Limbs |
| Bluetooth 2.4GHz | No |

**Note:**

1. As per KDB 4474898 D04, the frequency bands with rated power including upper tolerance, which qualify for Standalone Test Exclusion, are as per the above table.
2. The details for the Maximum Rated Power and tolerance(s) can be found in section 6.
3. BT LE operation is exempt from SAR test as per Module FCC ID: SQGBL652 certification

# 8.Conducted output power measurements

## 8.1.RF Output Average Power Measurement: Bluetooth 2.4 GHz

| Channel Number | Frequency (MHz) | Avg Power (dBm) | Operating Mode |
|---|---|---|---|
| 0 | 2402.0 | 14.60 | EDR (GFSK) |
| 39 | 2441.0 | 15.00 | |
| 78 | 2480.0 | 15.00 | |

# 9. Measurements, Examinations and Derived Result

## 9.1. Specific Absorption Rate - Test Results

### Test Approach

The SAR test is evaluated on each mode / configuration (Configuration: Head, Body-worn and extremity) on the channel measuring the highest average output power, in each frequency band (i.e.: DTS)

In the cases where the different channel bandwidth modes have the same highest measured average power, the largest channel bandwidth configuration has been selected.

### 9.1.1. Bluetooth Body 10g - BT Ant 1

**Max Reported SAR = 0.30 (W/kg)**

| | | | | | Power (dBm) | | 10g: SAR Results (W/kg) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Mode | Dist. (mm) | EUT Position | Channel Number | Freq (MHz) | Tune Up Limit | Meas. | Meas. SAR Level | Reported SAR | Notes | Plot No. |
| GFSK | 0 | Top | 39 | 2441 | 16.00 | 15.00 | 0.13 | 0.16 | - | - |
| GFSK | 0 | Bottom | 39 | 2441 | 16.00 | 15.00 | 0.01 | 0.00 | - | - |
| GFSK | 0 | Left | 39 | 2441 | 16.00 | 15.00 | 0.17 | 0.21 | - | - |
| GFSK | 0 | Back | 39 | 2441 | 16.00 | 15.00 | 0.01 | 0.02 | - | - |
| GFSK | 0 | Left | 0 | 2402 | 16.00 | 14.60 | 0.22 | 0.30 | - | 001 |
| GFSK | 0 | Left | 78 | 2480 | 16.00 | 15.00 | 0.13 | 0.17 | - | - |

### 9.1.2.Bluetooth Body 10g - BT Ant 2

**Max Reported SAR = 0.13 (W/kg)**

| | | | | | Power (dBm) | | 10g: SAR Results (W/kg) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Mode | Dist. (mm) | EUT Position | Channel Number | Freq (MHz) | Tune Up Limit | Meas. | Meas. SAR Level | Reported SAR | Notes | Plot No. |
| GFSK | 0 | Top | 39 | 2441 | 16.00 | 15.00 | 0.06 | 0.07 | - | - |
| GFSK | 0 | Bottom | 39 | 2441 | 16.00 | 15.00 | 0.04 | 0.05 | - | - |
| GFSK | 0 | Right | 39 | 2441 | 16.00 | 15.00 | 0.08 | 0.10 | - | - |
| GFSK | 0 | Right | 0 | 2402 | 16.00 | 14.60 | 0.10 | 0.13 | - | 002 |
| GFSK | 0 | Right | 78 | 2480 | 16.00 | 15.00 | 0.07 | 0.09 | - | - |

## 9.2.SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

### 10g-SAR (Extremity)

1) Repeated measurement is not required when the original highest measured SAR is < 2.0 W/Kg; steps 2) through 4) do not apply.
2) When the original highest measured 10g-SAR is ≥ 2.00 W/Kg, repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 3.625 W/kg (~ 10% from the 10g-SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 3.75 W/Kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Note: Since the 10g measured SAR for none of the runs was > 2.0 W/Kg, repeat measurements were not performed on Extremity.

# 10.Highest Standalone SAR and Simultaneous Transmission

## 10.1.Highest Standalone Reported SAR

### Individual Transmitter Evaluation per Band:

| Exposure Configuration | Technology Band | Reported 10g - SAR (W/Kg) | Equipment Class | Highest Reported 10g -SAR (W/Kg) |
|---|---|---|---|---|
| EXTREMITY (Separation Distance 0mm) | Bluetooth (EDR) | 0.30 | DSS | 0.30 |

## 10.2.Simultaneous Transmission analysis

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the *reported* standalone SAR of each applicable simultaneous transmitting antenna. The worst-case simultaneous transmission analysis is considered for the following cases:

**Note:** No simultaneous transmission analysis is evaluated as this feature is not supported between all Bluetooth transmitters